Claims

[c1] Claim 1. A method of fabricating a semiconductor structure, comprising steps of:
forming a first feature of a first active device and a second feature of a second active device;
introducing a first amount of nitrogen into the first feature of the first active device; and
introducing a second amount of nitrogen into the second feature of the second active device, the second amount of nitrogen being different from the first amount of nitrogen.

[c2] Claim 2. A method of fabricating a semiconductor structure according to claim 1 wherein:
the semiconductor structure includes a substrate having a top surface and a dielectric layer on the substrate;
the first feature is a first portion of the dielectric layer; and
the second feature is a second portion of the dielectric layer.

[c3] Claim 3. A method of fabricating a semiconductor structure according to claim 2, wherein:
the step of introducing a second amount of nitrogen into

the second feature of the second active device includes:
removing portions of the dielectric layer corresponding to the second active device, thereby exposing a portion of the top surface of the substrate;
forming a nitride film on the exposed portion of the top surface of the substrate; and
oxidizing the nitride film to form an oxynitride portion of the dielectric layer, the oxynitride portion having an amount of nitrogen that is less than the first amount of nitrogen introduced into the first portion of the dielectric layer.

[c4] Claim 4. A method of fabricating a semiconductor structure according to claim 1, wherein:
the semiconductor structure includes a substrate having a first well and a second well;
the first feature is the first well; and
the second feature is the second well.

[c5] Claim 5. A method of fabricating a semiconductor structure according to claim 4, wherein:
the step of introducing a first amount of nitrogen into the first feature of the first active device includes implanting a first amount of nitrogen into the first well; and
the step of introducing a second amount of nitrogen into the second feature of the second active device includes implanting a second amount of nitrogen into the second

well.

[c6] Claim 6. A method of fabricating a semiconductor structure according to claim 5, further comprising a step of forming a dielectric layer on the substrate surface adjacent to the first well and the second well, a first portion of the dielectric layer corresponding to the first well and a second portion of the dielectric layer corresponding to the second well;
wherein the implanted first amount of nitrogen is greater than the implanted second amount of nitrogen, a portion of the first amount of nitrogen diffuses into the first portion of the dielectric layer, and a portion of the second amount of nitrogen diffuses into second portion of the dielectric layer.

[c7] Claim 7. A method of fabricating a semiconductor structure according to claim 1, wherein:
the semiconductor structure includes a substrate, a first gate, a first gate dielectric layer between the first gate and the substrate, a second gate, and a second gate dielectric layer between the second gate and the substrate;
the first feature is the first gate; and
the second feature is the second gate.

[c8] Claim 8. A method of fabricating a semiconductor structure according to claim 7, wherein:

the step of introducing a first amount of nitrogen into the first feature of the first active device includes implanting a first amount of nitrogen into the first gate; and

the step of introducing a second amount of nitrogen into the second feature of the second active device includes implanting a second amount of nitrogen into the second gate;

wherein the implanted first amount of nitrogen is greater than the implanted second amount of nitrogen, a portion of the first amount of nitrogen diffuses from the first gate into the first gate dielectric layer, and a portion of the second amount of nitrogen diffuses from the second gate into the second gate dielectric layer.

[c9] Claim 9. A method of fabricating a semiconductor structure comprising steps of:

forming a dielectric layer on a semiconductor substrate, the dielectric layer having a first portion corresponding to a first dielectric gate and a second portion corresponding to a second dielectric gate;

introducing a first concentration of nitrogen into the first portion of the dielectric layer; and

introducing a second concentration of nitrogen into the second portion of the dielectric layer, the second concentration of nitrogen being different than the first con-

centration of nitrogen.

[c10] Claim 10. A method of fabricating a semiconductor structure according to claim 9, wherein:
the first portion of the dielectric layer has a first thickness, the first thickness being susceptible to appreciable dopant diffusion and current leakage; and
the second portion of the dielectric layer has a second thickness, the second thickness being susceptible to appreciable dopant diffusion and current leakage.

[c11] Claim 11. A method of fabricating a semiconductor structure according to claim 9, wherein the second concentration of nitrogen is less than the first concentration of nitrogen.

[c12] Claim 12. A method of fabricating a semiconductor structure according to claim 9, wherein
the step of introducing a first amount of nitrogen into the first portion of the dielectric layer includes a step of one of:
rapid thermal nitridation;
furnace nitridation;
remote plasma nitridation;
decoupled plasma nitridation;
well implantation; or
polysilicon implantation; and

the step of introducing a second amount of nitrogen into the second portion of the dielectric layer includes a step of one of:
rapid thermal nitridation;
furnace nitridation;
remote plasma nitridation;
decoupled plasma nitridation;
well implantation; or
polysilicon implantation.

[c13] Claim 13. A method of fabricating a semiconductor structure according to claim 9, wherein
the first concentration of nitrogen is sufficient to prevent appreciable gate leakage and dopant penetration in the first dielectric gate without causing an appreciable threshold-voltage shift in the first portion of the dielectric layer; and
the second concentration of nitrogen is sufficient to prevent appreciable gate leakage and dopant penetration in the second dielectric gate without causing an appreciable threshold-voltage shift in the second portion of the dielectric layer.

[c14] Claim 14. A semiconductor structure comprising:
a semiconductor substrate;
a first active device formed on the substrate, the first active device having a first dielectric gate, which has a first

concentration of nitrogen; and
a second active device formed on the substrate, the second active device having a second dielectric gate, which has a second concentration of nitrogen different than the first concentration of nitrogen.

[c15] Claim 15. A semiconductor structure according to claim 14, wherein:
the first dielectric gate has a first thickness susceptible to appreciable dopant diffusion and current leakage; and
the second dielectric gate has a second thickness susceptible to appreciable dopant diffusion and current leakage.

[c16] Claim 16. A semiconductor structure according to claim 15, wherein the second concentration of nitrogen is less than the first concentration of nitrogen.

[c17] Claim 17. A semiconductor structure according to claim 16, wherein the second active device is a p-channel field effect transistor and the first active device is an n-channel field effect transistor.

[c18] Claim 18. A semiconductor structure according to claim 14, wherein
the first dielectric gate has a first thickness being susceptible to appreciable dopant diffusion or current leak-

age; and
the second dielectric gate having a second thickness not being susceptible to appreciable dopant diffusion or current leakage.

[c19] Claim 19. A semiconductor structure according to claim 18, wherein the second concentration of nitrogen is less than the first concentration of nitrogen.

[c20] Claim 20. A semiconductor structure according to claim 15, wherein
the first thickness and second thickness are less than about fifty angstroms.

[c21] Claim 21. A semiconductor structure according to claim 18, wherein
the first thickness is less than about fifty angstroms; and
the second thickness is about fifty angstroms or greater.

[c22] Claim 22. A semiconductor structure according to claim 14, wherein the first concentration of nitrogen and the second concentration of nitrogen were selectively introduced by one or more processes including one of:
rapid thermal nitridation;
furnace nitridation;
remote plasma nitridation;
decoupled plasma nitridation;

well implantation; and
polysilicon implantation.

[c23] Claim 23. A semiconductor structure according to claim 14, wherein the first concentration of nitrogen is about 8 x 10^{14} to 1 x 10^{22} atoms/centimeter^2.

[c24] Claim 24. A semiconductor structure according to claim 14, wherein
the first concentration of nitrogen is sufficient to prevent appreciable gate leakage and dopant penetration in the first dielectric gate without causing an appreciable threshold-voltage shift in the first dielectric gate.

[c25] Claim 25. A semiconductor structure according to claim 24, wherein the second concentration of nitrogen is about 1 x 10^{13} to 1 x 10^{15} atoms/centimeter^2.

[c26] Claim 26. A semiconductor structure according to claim 14, wherein the second concentration of nitrogen is sufficient to prevent appreciable gate leakage and dopant penetration in the second dielectric gate without causing an appreciable threshold-voltage shift in the second dielectric gate.

[c27] Claim 27. A method of fabricating a semiconductor structure comprising steps of:
forming a first nitrogen-containing layer on a substrate

surface, the first nitrogen-containing layer having a first nitrogen concentration;

forming a second nitrogen-containing layer on a substrate surface, the second nitrogen-containing layer having a second nitrogen concentration, the second nitrogen concentration being less than the first nitrogen concentration; and

oxidizing the first and second nitrogen-containing layers to form a dielectric layer having a first portion with a first thickness corresponding to the first nitrogen containing layer and a second portion with a second thickness corresponding to the second nitrogen-containing layer, the second thickness being greater than the first thickness.

[c28] Claim 28. A method of fabricating a semiconductor structure according to claim 27, wherein the second thickness is less than approximately 50 angstroms.

[c29] Claim 29. A method of fabricating a semiconductor structure according to claim 27, wherein the first portion of the dielectric layer corresponds to an n-channel field effect transistor and the second portion of the dielectric layer corresponds to a p-channel field effect transistor.

[c30] Claim 30. A method of fabricating a semiconductor structure according to claim 27, wherein the dielectric

layer is comprised of an oxynitride dielectric material.